COMBATING INVASIVE PLANTS IN COMMUNITY FORESTS

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INVASIVE SPECIES

“With regard to a particular ecosystem, a non-native organism whose introduction causes, or is likely to cause economic or environmental harm or harm to human, animal or plant health”

Billions in damage and control cost in the United States annually (up to trillions worldwide).

Worldwide impact is second only to human population growth as a cause of biodiversity loss (Pimentel, 2011)

Most plant invaders were introduced in the US for food, fiber, and ornamental purposes.

About 5,000 (out of about 25,000 exotic plants) exist in U.S. natural ecosystems compared to about 17,000 native species
INVASIVE SPECIES IN GA FORESTS

- A field guide for the identification of invasive plants in southern forests (General Tech. Report from USDA Forest Service) lists 56 nonnative species invading forests in 13 southern states.

- Georgia Exotic Pest Plant Council (GA-EPPC) separates invasive plants in GA into four major categories.
  - 20 species are listed as **Category 1**
  - “Exotic plant that is a **serious problem** in Georgia natural areas by **extensively invading** native plant communities and **displacing** native species”
### Category 1 Exotic Pests in Georgia Forests

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Habit</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ailanthus altissima</td>
<td>Tree-of-heaven</td>
<td>tree</td>
<td>Eastern China</td>
</tr>
<tr>
<td>2 Albizia julibrissin</td>
<td>Silktree, mimosa</td>
<td>tree</td>
<td>Asia</td>
</tr>
<tr>
<td>3 Elaeagnus umbellata</td>
<td>Autumn olive</td>
<td>shrub</td>
<td>Japan &amp; China</td>
</tr>
<tr>
<td>4 Hedera helix</td>
<td>English ivy</td>
<td>vine</td>
<td>Europe</td>
</tr>
<tr>
<td>5 Ligustrum sinense</td>
<td>Chinese privet</td>
<td>shrub</td>
<td>East Asia</td>
</tr>
<tr>
<td>6 Melia azedarach</td>
<td>Chinaberry tree</td>
<td>tree</td>
<td>Asia</td>
</tr>
<tr>
<td>7 Lonicera japonicum</td>
<td>Japanese honeysuckle</td>
<td>vine</td>
<td>Japan</td>
</tr>
<tr>
<td>8 Paulownia tomentosa</td>
<td>Princesstree</td>
<td>tree</td>
<td>East Asia</td>
</tr>
<tr>
<td>9 Pueraria montana</td>
<td>Kudzu</td>
<td>vine</td>
<td>Japan &amp; China</td>
</tr>
<tr>
<td>10 Rosa multiflora</td>
<td>Multiflora rose</td>
<td>shrub</td>
<td>Asia</td>
</tr>
<tr>
<td>11 Triadica sebifera</td>
<td>Chinese tallowtree</td>
<td>tree</td>
<td>China</td>
</tr>
<tr>
<td>12 Wisteria sinensis</td>
<td>Chinese wisteria</td>
<td>vine</td>
<td>Asia</td>
</tr>
</tbody>
</table>
Category 2 Pests in Georgia

“Exotic plant that is a moderate problem in Georgia natural areas by invading native plant communities and displacing native species, but to a lesser degree than category 1”

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Habit</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ardisia crenata</td>
<td>Coral ardisia</td>
<td>shrub</td>
<td>Japan and India</td>
</tr>
<tr>
<td>2 Cinnamomum camphora</td>
<td>Camphortree</td>
<td>tree</td>
<td>Japan, China, Taiwan</td>
</tr>
<tr>
<td>3 Elaeagnus pungens</td>
<td>Thorny olive</td>
<td>shrub</td>
<td>Japan &amp; China</td>
</tr>
<tr>
<td>4 Ligustrum japonicum</td>
<td>Japanese privet</td>
<td>shrub</td>
<td>East Asia</td>
</tr>
<tr>
<td>5 Lonicera maackii</td>
<td>Amur honeysuckle</td>
<td>shrub</td>
<td>Asia</td>
</tr>
<tr>
<td>6 Nandina domestica</td>
<td>Sacred bamboo</td>
<td>shrub</td>
<td>Eastern Asia &amp; India</td>
</tr>
<tr>
<td>7 Spiraea japonica</td>
<td>Japanese spirea</td>
<td>shrub</td>
<td>Eastern Asia</td>
</tr>
</tbody>
</table>
WHY ARE THEY INVASIVE?

- Majority (though not all) invasive species are exotic.
- Exotic = escaping from their natural enemies (predators, herbivores, diseases).
- Aggressive invasives have some common traits:
  - Fast growth
  - Shade tolerance
  - Dense infestations
  - High seed densities often spread by animals
  - Sprouting from roots and underground shoots
  - Earlier leaf-out than native species
FEDERAL ACTION

- Legal patchwork – numerous federal laws deal with invasives (at least 19)
  - Georgia invasive species task force lists these along with summary of what each law covers
    https://www.gainvasives.org/regulations/

- Many laws yet invasives continue to spread, why?

- None of the laws is all encompassing, most are restricted to specific sectors, pathways, or species

- Maybe consolidation of legal authority and agency responsibility for invasives?
CONTROL & ERADICATION

- Many invasives have had decades to establish so fighting them will take decades and money!!
- Preventing introduction – by promoting and encouraging use of native species
- Making treatment and monitoring of invasives part of well designed management strategies for all forest programs
- Coordinated action between public and private stakeholders
Treatment

- Often requires integration of multiple treatments for effective control, most commonly mechanical + chemical
  - Cutting alone often results in resprouts
  - Burning does not control roots and rhizomes
  - Mechanical root raking can intensify spread by chopping roots into resprouting segments
  - Overgrazing can increase spread through seed dispersal
  - Selective herbicides offer best option because they can kill roots
Web Resources for specific treatment

- Georgia Exotic Pest Plant Council [https://www.gaeppc.org/](https://www.gaeppc.org/)
- Invasive Plants of the Eastern United States: Identification and Control [www.invasive.org/eastern](www.invasive.org/eastern)
- Invasive plant atlas of the United States [https://www.invasiveplantatlas.org/index.cfm](https://www.invasiveplantatlas.org/index.cfm)
CONTRIBUTION TO CLIMATE CHANGE

http://www.nasa.gov/content/goddard/enormous-aquifer-discovered-under-greenland-ice-sheet/index.html
THE GLOBAL CARBON CYCLE

Figure 7.1: A simplified carbon cycle. Diagram adapted from U.S. DOE, Biological and Environmental Research Information System.
Chinese privet (CHP) research

- *Ligustrum sinense* Lour. Native to SE Asia, introduced as an ornamental in 1852.
Species richness & tree density

- Significantly lower species richness, tree density, and sapling density in heavy CHP samples than non-invaded samples ($P < 0.01$).

<table>
<thead>
<tr>
<th></th>
<th>No CHP</th>
<th>Heavy CHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree density (# trees/ha)</td>
<td>1594</td>
<td>533</td>
</tr>
<tr>
<td>Richness (# species/sample)</td>
<td>5</td>
<td>2.6</td>
</tr>
<tr>
<td>Sapling density (individuals/ha)</td>
<td>412</td>
<td>33</td>
</tr>
</tbody>
</table>
Tree distribution by DBH size

- **Heavy CHP**
  - Tree density (trees/ha)
  - Tree DBH (cm)
  - No CHP
Future of wooded natural areas

Without enough juvenile native trees to replace old or fallen canopy trees, wooded natural areas will degenerate into areas dominated by invasive shrubs like privet and honeysuckle.

In the absence of serious intervention, such an outcome seems inevitable.
Amount of Carbon in forest biomass

Significantly less C in heavy CHP samples than non-invaded samples ($P < 0.01$).

Boxplot of C (kg/sample)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mean C (kg/ha)</th>
<th>Average deficit</th>
<th>Percent deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CHP</td>
<td>334,358</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHP (W/O CHP-C)</td>
<td>108,386</td>
<td>(225,972)</td>
<td>67.58</td>
</tr>
<tr>
<td>CHP (CHP-C added)</td>
<td>118,971</td>
<td>(215,386)</td>
<td>64.42</td>
</tr>
</tbody>
</table>
Decomposition

- Nov 2017 – Aug 2019 – used the litterbag (20 cm x 20 cm) method to compare decomposition rates of different litter combinations
Decomposition rates

- CHP litter decomposed significantly faster than the other treatments ($P < 0.001$)

- CHP litter starting with significantly higher N content than non-CHP ($P < 0.001$)

Average remaining mass as a percent of initial mass (g)(mean ± 1SE)

Average percent C:N ratio with time (mean ± 1SE)
Heavy presence of Chinese privet results in loss in C sequestration capacity of native forests.

This potentially adds to the “land use change” flux of the C-cycle thus contributing to increase in atmospheric C.
Further Research

- Current on-going work is assessing amount of soil organic C under heavy privet vs no privet
  - Every ha forest with heavy CHP presence stores less C in live biomass.
  - Less live biomass means less litter to the forest floor, which is an important source of soil C
  - Long term consequence might be significant decrease in soil C due to loss in litter supply.
Some references

Acknowledgements

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